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Original article

Prevalence and ultrasound features of polycystic ovaries in young unmarried Saudi females

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ABSTRACT

Polycystic ovary (PCO) is a highly variable condition with a wide array of presentations. The polycystic ovary syndrome should meet at least two of the following three criteria: oligo- or anovulation; clinical and/or biochemical signs of hyperandrogenism; polycystic ovaries on ultrasound. The prevalence of PCO is largely unknown in Saudi Arabia. This study presents the prevalence of PCO in young unmarried female students of Taibah University Almadinah Almunawwarah, presenting with menstrual irregularities. The agreed ultrasound features of PCO i.e. presence of 12 or more 2–9 mm ovarian follicles; a peripheral distribution of ovarian follicles; an ovarian volume of more than 10 cm^3 and a highly echogenic ovarian stroma were analyzed in all 108 patients. The criteria of 12 or more 2–9 mm ovarian follicles were found to have highest sensitivity in establishing the diagnosis of PCO.

1. Introduction

Polycystic ovary syndrome (PCOS) is a malfunction with ovarian overproduction of androgens with main features of hyperandrogenism and an ultrasound appearance of polycystic ovaries [1]. The European Society of Human Reproduction and Embryology/American Society for Reproductive Medicine criteria, often called Rotterdam, includes various phenotypes based on a combination of any two of the three findings of hyperandrogenism, menstrual irregularity, and polycystic ovaries on ultrasound [2]. However, a wealth of literature agrees that women may present an appearance of PCO at ultrasound without any sign of androgen excess, although with indicators of ovarian dysfunction [3]. PCOS remains a syndrome and as such, no single diagnostic feature is sufficient in itself to establish the clinical diagnosis. Similarly, PCOS is diagnosed by exclusion, and disorders having a phenotype related to that of PCOS must be ruled out; such as congenital adrenal hyperplasia, Cushing syndrome and virilising tumors [4].

Since the advent of ultrasound, numerous diagnostic parameters have been coined to morphologically define PCO, but there is still no consensus as to their respective diagnostic value. The present study aims to report prevalence of PCO in students of Taibah University with an overview of the salient ultrasound features of PCO.

2. Materials and methods

This cross sectional clinical study was conducted at the Medical Center of Taibah University Almadinah Almunawwarah Saudi Arabia during the period January 2012 through December 2012. All consecutive unmarried female students of Taibah University (faculties of medicine, science, literature, and computer sciences), with menstrual irregularities, acne, and hirsutism, aged 18–28 years were recruited in the study. Students with diabetes mellitus, thyroid and adrenal disorders and on hormonal replacement therapy (HRT) were excluded from the study. Menstrual

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Table 1
Manifestations of PCO in term of clinical and menstrual abnormalities in the study ($N = 108$).

No.	Features	No. (%)
1	Age (years)	21.3 ± 2.1
2	Patients with hirsutism	39 (36.1)
3	Patients with acne	34 (31.4)
4	Patients with hirsutism and acne	58 (53%)
5	Patients with oligomenorrhea	87 (80.5)
6	Patients with amenorrhea	21 (19.5)

irregularities were defined as; chronic anovulation as amenorrhea of 3 months duration or oligomenorrhea as intermenstrual interval > 35 days. Regular menstruation was defined as 9–16 cycles of a 21–35 days duration within a year and no more than a 4-day difference in duration between cycles [5]. The participants had pelvic ultrasound scan with full bladder, and those found to have ultrasound criteria of PCO were included in the final group and the data was stored on Microsoft Excel for further analysis. The evaluated ultrasound criteria of PCO were; the presence of 12 or more 2–9-mm ovarian follicles; a peripheral distribution of ovarian follicles; an ovarian volume of more than 10 cm^3 and a highly echogenic ovarian stroma [6]. Only one ovary fitting this definition was considered enough to label PCO [2]. All ultrasonic examinations were performed by a single, experienced sinologist. Ethical approval was taken from the Institution Review Board and a written informed consent was taken from all the participants.

Transabdominal ultrasound was performed between cycle days 2 and 7 or during any day of amenorrhea, utilizing a 6 MHz curved-array scanner of transabdominal transducer (Toshiba Ultrasound System Nemio20 CA) with a full urinary bladder. Ultrasound measurements were taken in real time, according to a standardized protocol. Gain settings were optimized with particular attention to the size of the patient and the amount of pelvic fat. After identification of the ovaries, the size of the ovary was measured in three orthogonal planes. The highest possible magnification was used to examine the ovaries. After the longest medial axis of the ovary had been measured, the ovarian length and thickness were outlined and the area was calculated using an automatic ellipse to outline the ovary as reported previously [7].

3. Results

From a cohort of 201 participants, 108 (53.7%) were diagnosed to have PCO with a mean age of 21.3 ± 2.1 years. The demographic details, menstrual irregularities and dermatological manifestations reported in 108 cases of PCO are illustrated in Table 1.

The ultrasound criteria of 12 or more follicles measuring 2–9 mm was the commonest finding observed in 97 (89.8%) patients, followed by the peripheral distribution of ovarian follicles in 89 (82.8%) as shown in Fig. 1.

Various radiological parameters shown by ultrasound scan are summarized in Table 2.

The ultrasound images from two patients with PCO are displayed in Figs. 2 and 3.

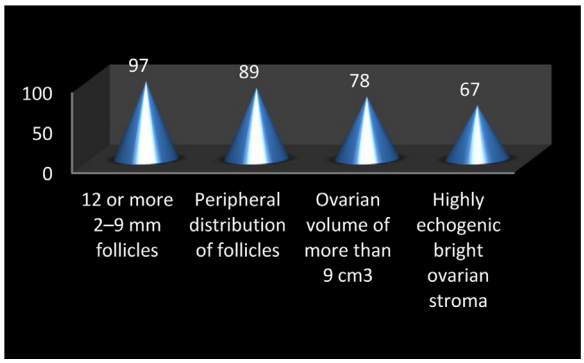

Fig. 1. The distribution of ultrasound criteria of PCOS in the study ($N = 108$).

4. Discussion

March et al. conducted a retrospective birth cohort study in which 728 women born during 1973–1975 in a single maternity hospital were traced and interviewed in adulthood (age ¼ 27–34 year; n ¼ 728 [8]. They reported a representative prevalence estimate of PCO in the community under the National Institutes of Health (NIH) criteria and the more recent Rotterdam consensus criteria and Androgen Excess Society (AES) criteria. They estimated that the prevalence of PCO using the NIH criteria was 8.7 + 2.0% (with no need for imputation). Under the Rotterdam criteria, the prevalence was 11.9 + 2.4% which increased to 17.8 + 2.8% when imputed data were included. Under the AES recommendations, PCO prevalence was 10.2 + 2.2%, and 12.0 + 2.4% with the imputed data. In the present study, the estimated prevalence was 53.7% which is strikingly higher than the previous data. One of the explanations may be the high incidence of obesity in Saudi Arabia which has an established association with PCOS. A study conducted on 29–43-year-old Saudi female patients with suggested diagnosis of PCOS illustrated the prevalence of 64.5% obese and 24.2% overweight cases [9]. Similarly, other investigators have described a high prevalence of obesity with infertility and PCOS [10–12].

The diagnosis of PCOS is based on the association of one clinical criterion [hirsutism (as assessed by a modified Ferriman and Gallwey score of >8) [13] or menstrual disturbances (i.e. oligomenorrhoea or amenorrhoea or cycle length either < 25 days or >35 days and/or ovulatory disturbances as assessed by basal body temperature chart and/or serum progesterone level < 3 ng/ml in luteal phase)], with either one biological criterion (serum LH levels > 6.5 UI/l, and/or testosterone levels > 0.7 ng/ml, and/or androstenedione levels > 2.2 ng/ml), or an ovarian

Table 2
Ultrasound features of polycystic ovaries in the study ($N = 108$).

Diagnostic criteria for PCO	Mean ± SD
Mean FNPO	28.7 ± 9.5
Maximum FSSP	14.8 ± 3.7
Ovarian volume	16.8 ± 5.3

FNPO; follicle number per ovary; FSSP; follicle in a single sonographic plane; ovarian volume in cm^3.

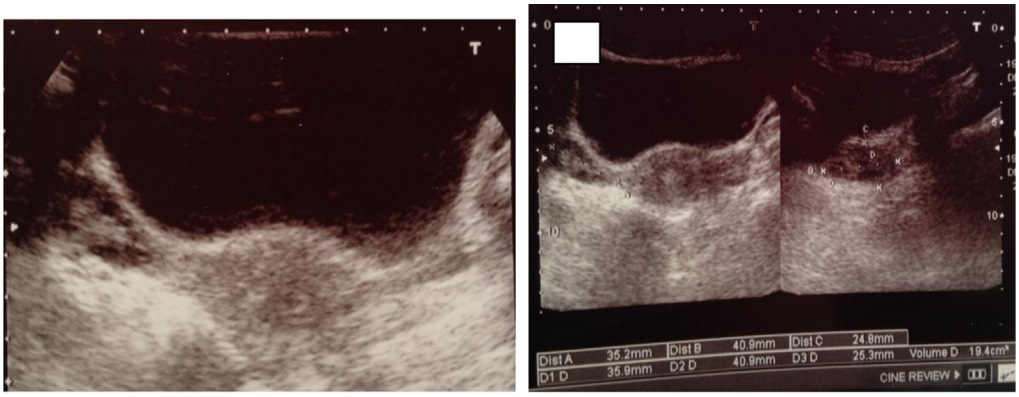

Fig. 2. (A and B): Transabdominal scan of right ovary showing more than 12 peripherally distributed follicles all measuring around 4 mm in diameter with echogenic central ovarian stroma, while in B, ovarian volume of 19.4 cm^3 is calculated.

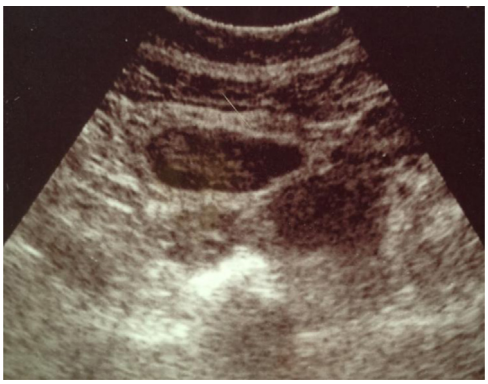

Fig. 3. Another patient showing enlarged ovary with bright echogenic stroma and peripheral distribution of follicles more than 12 in number seen on a single sonographic plane.

area > 10 cm^2 unilaterally or bilaterally at ultrasound [14,15]. Blood sampling is performed during the early follicular phase i.e. between days 2 and 7 after the last menstrual period which is either spontaneous or induced by the administration of didrogesterone (10 mg/day for 7 days). This reflects the complex nature of PCOS and the treating physician must note that every single clinical, menstrual, hormonal and biochemical parameter will not be encountered in each patient.

The prevalence of hirsutism associated with PCO in this study (39%) was higher than a Greek prevalence study of 29% [16] and three other PCOS prevalence studies [17–19]. The lower hirsutism prevalence in other studies may be a reflection of alternate methodologies and selection criteria employed for defining hirsutism.

Pelvic ultrasound is important not only for the definition of polycystic ovary syndrome but also for detecting androgens producing ovarian tumors and sexual development abnormalities [20]. The ultrasound criteria for polycystic ovary are the presence of 12 or more follicles measuring 2–9 mm in diameter or an ovarian volume greater than 10 cm^3 in at least one ovary. If a single follicle is greater than 10 mm in largest diameter, the ultrasound should be repeated later to calculate again the ovarian volume and area. The peripheral distribution of follicles in "string of pearls" and hyperechogenicity of the stroma are classical ultrasound features [21]. Both hormonal work-up and ultrasound should be carried out without hormonal contraception. In the present study, the highest sensitivity for the ultrasound criteria of PCO was found to be 12 or more 2–9 mm follicles found in 97 (89.8%) cases. This finding substantiates the theory of follicular arrest, which proposes that the progression of small antral follicles to selected follicles (6 ± 9 mm in size) and to the dominant follicle cannot proceed normally in PCO [22]. This phenomenon is crucial in determining the anovulation of PCO, and it has been shown to be closely related to obesity and hyperinsulinism. Since ultrasound can only detect follicles > 2 mm in size, the multifollicular nature of PCO can be confused with the other causes of multifollicular ovaries (MFO) in which only the latest stages of follicular development (>4 mm) are involved. Indeed, MFO are observed by ultrasound in various physiological and pathological situations, such as mid ± late normal puberty, central precocious puberty, hypothalamic anovulation, hyperprolactinaemia [15]. This raises the question of which threshold should be accepted if follicle number per ovary is used to diagnose PCO. The majority of authors have set this threshold at 10 (Adams et al., 1985; Takahashi et al., 1994) but some authors have recommended 15 (Fox et al., 1991).

Although increased stromal ovarian volume is a characteristic feature of PCO [23], determination of ovarian size has been shown to be a good replacement for quantitation of stromal volume in clinical practice. This definition does not apply to women using oral contraceptives since the latter can alter ovarian morphology in normal women and possibly in subjects with PCO [24]. A study calculated stromal index (ratio of mean stromal echogenicity to mean echogenicity of the entire ovary) and total stromal echogenicity [25]. There was no difference in the mean stromal echogenicity, although the stromal index was significantly greater in women with PCO. The apparent subjective increase in stromal echogenicity in PCO, as exemplified by the greater stromal index, was due to a combination of the increased

volume of ovarian stroma and the significantly lower mean echogenicity of the entire ovary in these women. Similar results were demonstrated in 67 (62%) patients which reflect low sensitivity of ovarian echogenecity in diagnosing PCO.

Transabdominal ultrasound has been largely superseded by transvaginal scanning because of greater resolution, and patient preference, as the need for a full bladder is avoided which saves time and may be more comfortable [23]. Transvaginal route must be used wherever possible, particularly in obese patients [26]. The transvaginal approach provides a more accurate view of the internal structure of the ovaries, avoiding apparently homogeneous ovaries as described with transabdominal scans, particularly in obese patients. With this route, high-frequency probes (>7 MHz), which have a better spatial resolution can be achieved with better results. The recent advent of three-dimensional (3-D) ultrasound, as well as color- and pulsed-Doppler ultrasound, may further enhance the detection of polycystic ovaries, and may be more commonly employed in time [27]. The present study was hampered by the fact the study population was virgin unmarried female students where transvaginal ultrasound could not be offered.

5. Study limitations

A referral bias could have occurred from including volunteers who participated in the study. Selected cohort of unmarried female students necessitated the application of pelvic ultrasound which is certainly less informative than its transvaginal counterpart. Another limitation is the small sample size, which affected the numerical strength of the study cohort.

6. Conclusion

The ultrasound diagnostic criteria of PCO have improved the quantitative analysis of the ovarian stroma and the objectivity of observations. With each successive refinement in the technology, the diagnostic accuracy has evolved from a mere appreciation of overall ovarian size to the recognition of characteristic follicular patterns of distribution and subtle textural changes in the ovarian stroma. The presence of 12 or more 2–9 mm follicles appears more sensitive than either ovarian volume or stromal brightness.

Conflict of interest

The author declares no conflict of interest.

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